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A PRELIMINARY PROCEDURE FOR PREDICTING THE POSITIVE AND NEGATIVE EFFECTS OF REINFORCEMENT-BASED PROCEDURES

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In the current investigation, a modification was made to the preference assessment described by Pace, Ivancic, Edwards, Iwata, and Page (1985) to predict the effects of stimuli when used in a differential-reinforcement-of-other-behavior (DRO) schedule for 2 clients with severe self-injurious behavior (SIB) and profound mental retardation. Based on the results of the preference assessment, three types of stimuli were identified: (a) high-preference stimuli associated with high rates of SIB (HP/HS), (b) high-preference stimuli associated with relatively lower rates of SIB (HP/LS), and (c) low-preference stimuli associated with low rates of SIB (LP/LS). Consistent with the results of the preference assessment, the DRO schedule with HP/HS stimuli resulted in increased SIB, and the DRO schedule with LP/LS stimuli resulted in no changes in SIB. HP/LS stimuli were demonstrated reinforcers but did not result in a change in SIB when used in a DRO schedule. Thus, the stimulus preference assessment may be useful clinically in some situations for predicting both the beneficial and the negative side effects of stimuli in DRO procedures.

DESCRIPTORS: developmental disabilities, differential reinforcement of other behavior, negative side effects, preference, reinforcement, self-injurious behavior

The successful treatment of self-injurious behavior (SIB) has been facilitated by the development of behavioral assessment procedures to prescribe treatments (e.g., Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994). In general, the goal of behavioral assessment procedures is to identify antecedent or consequent events that occasion or maintain maladaptive behavior. For example, Carr and Durand (1985) taught clients to ask for help or attention instead of using maladaptive behavior. Touchette (1985) used the results of a scatter-plot analysis to rearrange the environment and to treat the problem behavior of clients with destructive behavior.

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In cases in which the results of functional analysis have been inconclusive, the results of systematic preference (e.g., Pace, Ivancic, Edwards, Iwata, & Page, 1985) and choice (e.g., Fisher et al., 1992) assessments have been used to treat SIB (e.g., Vollmer, Marcus, & LeBlanc, 1994). During preference and choice assessments, stimuli are presented to clients either individually or in pairs. Responses to the stimuli (e.g., reaching for or manipulating the stimulus) serve as the dependent variable. Stimuli that occasion approach responses during 80% of trials are usually defined as high-preference stimuli. During a subsequent reinforcer assessment, the reinforcing effects of highly preferred stimuli are then assessed directly. In many investigations in which reinforcer effectiveness is evaluated (e.g., Fisher et al., 1992; Pace et al., 1985), simple target responses (e.g., sitting in a chair, raising one's hand) are used as the dependent variable. In general, highly preferred stimuli function as reinforcers for simple free-operant responses. However, the extent to which stimuli identified as reinforcers for simple free-operant behaviors will effectively compete with the consequences of automatically maintained SIB remains unclear. That is, a stimulus identified as a reinforcer in one context or for one behavior may not function as a reinforcer in another context for a different behavior.

Vollmer et al. (1994) used the results of choice assessments for 3 clients with SIB to develop enriched environment treatments wherein clients were given noncontingent access to preferred stimuli. For all clients, SIB was reduced during environmental enrichment. Further reductions in SIB were achieved for 2 clients when appropriate toy play was reinforced and for 1 client when a brief time-out procedure was added to treatment. Thus, in the Vollmer et al. (1994) investigation, the stimuli identified through the preference assessment appeared to compete effectively with the presumed reinforcers for SIB.

Although access to functional reinforcers may result in reductions in maladaptive behavior (e.g., Dyer, 1987; Mason, McGee, Farmer-Dougan, & Risley, 1989; Vollmer et al., 1994), not all reinforcement-based procedures have been effective (e.g., Cavalier & Ferretti, 1980; Corte, Wolf, & Locke, 1971; Foxx & Azrin, 1973; Friman, Barnard, Altman, & Wolf, 1986), and reinforcement-based procedures can sometimes produce negative side effects (Balsam & Bondy, 1983; Cowdery, Iwata, & Pace, 1990). In cases in which SIB may be maintained by automatic consequences, it is possible that procedures based on stimulus preference and reinforcer assessments may fail when the identified reinforcers do not effectively compete with the consequences of SIB. Further, negative side effects, such as increases in SIB, may occur when identified stimuli occasion SIB. One potential method for improving the outcome of reinforcement-based procedures is to develop behavioral assessment strategies that predict both the beneficial and the negative effects of reinforcement. For example, preference assessments are designed to predict the reinforcing effects of stimuli on simple free-operant behavior, but often do not provide information about the extent to which the stimuli effectively compete with SIB or the potential negative side effects associated with the stimuli. Thus, it may be important to conduct stimulus preference assessments that directly assess the relationship between preferred stimuli and SIB.

The goal of the current investigation was to propose a preliminary procedure for assessing both beneficial (i.e., reinforcing) and negative effects of differential reinforcement procedures using a modification of the preference assessment described by Pace et al. (1985). The modification consisted of conducting concurrent observations of preference and SIB during stimulus presentation to predict which stimuli would effectively compete with or occasion SIB when subsequently used in a differential-reinforcement-of-other-behavior (DRO) schedule.

PHASE 1: FUNCTIONAL ANALYSIS

Method

Subjects

Two individuals with severe SIB were admitted to an inpatient unit specializing in treatment of severe behavior disorders. Mel was a 27-year-old woman who had been diagnosed with profound mental retardation, spastic diplegia, and microcephaly and whose SIB included head banging and hitting, ear scratching, and hand biting. Her SIB had resulted in severe tissue damage in the form of bleeding, bruising, and scarring to her hands, neck, and ears. Mel was completely dependent upon others for all of her self-care needs (eating, toileting, bathing, and dressing). She did not use any recognizable means to communicate. Her spastic diplegia resulted in limited locomotor abilities; she could bear weight with assistance and take some steps, but she spent the majority of the day in a wheelchair.

Mark was an 8-year-old boy who had been diagnosed with profound mental retardation, bilateral vocal cord paralysis, and subglottic stenosis. Mark had a tracheostomy and gastrostomy tube and did not consume anything by mouth. Mark's SIB consisted of fist-to-head blows and head banging and kicking. When Mark was admitted to the hospital, he was unable to sit up or bear weight on his legs due to poor muscle tone. Mark used a wheelchair for transportation and, prior to his hospitalization, spent his day lying in bed or seated in a wheelchair. He also did not use any recognizable methods of communication and was entirely dependent upon others for all of his self-care needs. Mark's SIB had resulted in severe tissue damage in the form of bleeding and bruising to the ears, head, and hands. Prior to his hospital admission, he spent most of his day restrained at the wrists, waist, and ankles due to the severity of his SIB.

Functional Analysis

Both clients participated in a functional analysis consisting of four analogue sessions similar to that described by Iwata et al. (1982/1994): (a) demand, (b) social attention, (c) alone, and (d) toy play. Sessions were 10 min in length and were conducted in a random order for each client. Sessions were conducted in an individual treatment room (3 m by 3 m) equipped with a one-way mirror. During all functional assessment sessions, the client was seated in his or her wheelchair. During social attention, the client was given toys and was prompted to play. The therapist presented social attention in the form of a brief verbal reprimand contingent upon the target response. Demand sessions were modified to closely approximate the client's routines used at home (i.e., both clients had never responded to simple requests and were not asked to do so at home). Therefore, during demand, the therapist performed activities of daily living with the client (e.g., the therapist brushed the client's teeth). The therapist provided brief verbal praise if the client "cooperated" (e.g., kept mouth opened during toothbrushing), and the therapist removed the task materials and terminated the task for 30 s if the client displayed SIB. During alone (i.e., ignore for Mel), the therapist stood behind Mel's wheelchair and held it but was out of Mel's sight in an otherwise empty treatment room. The therapist was present in the room to prevent Mel's wheelchair from overturning during episodes of intense head banging. Mark was alone in an otherwise empty treatment room. During toy play for Mel, the therapist played with Mel and praised her approximately once every 30 s contingent on the first 5-s period in which SIB was absent. During toy play for Mark, the therapist provided continuous attention throughout the session and no differential consequence for SIB.

Data Collection and Reliability Checks

During all functional assessment sessions, trained observers recorded rate (responses per minute) of SIB on laptop computers. SIB for Mel was defined as head banging, head hitting, hand biting, and ear scratching, and for Mark it was defined as head hitting with fist or foot and head banging on any object.

Two independent observers scored target responses simultaneously but independently during 64% and 85% of functional assessment sessions for Mel and Mark, respectively. Exact agreement coefficients were calculated by partitioning each session into 10-s intervals. Within each interval, two observers could (a) agree on the exact number of behaviors that occurred, (b) agree that the behavior did not occur, or (c) disagree about the exact number of behaviors that occurred (disagreement). Exact agreement coefficients were calculated by dividing the number of agreements by the sum of agreements plus disagreements and multiplying by 100%. Mean exact agreement was 93% for Mel and 98% for Mark.

Experimental Design

A multielement design was used to assess the clients' behavior in the four functional analysis conditions. Forty-five sessions were conducted with Mel, and 40 sessions were conducted with Mark.

Results and Discussion

The results of the functional analyses for each client are depicted in Figure 1. For Mel, rates of SIB were variable across functional analysis conditions. The mean rate of SIB was 8.5 per minute in the ignore condition, 9.4 per minute in the social attention condition, 12 per minute in the demand condition, and 11.7 per minute in the toy play condition. For Mark, rates of SIB were more stable between conditions but were variable from session to session. Mean rate of SIB was 2.4 per minute in the alone condition, 2.1 per minute in the social attention condition, 1.8 per minute in the demand condition, and 1.5 per minute in the toy play condition. Treatments based on functional analysis could not be developed, because the analyses were inconclusive for both clients. That is, SIB occurred in all conditions, possibly suggesting that SIB was maintained by automatic reinforcement or was not an operant response.

Several additional analyses were conducted with each client to evaluate the possibility that these results occurred due to multiple treatment interference. Analyses were also conducted to further assess the potential sensory or automatic consequences of the behavior. To assess multiple treatment interference, daily schedules were constructed that consisted of intervals of demands, high and low social interactions, and access to high- and low-preference items. No differences occurred between rates of behavior across the various conditions. To further assess sensory reinforcement, analyses were conducted with a variety of sensory stimuli to identify forms of sensory stimulation that might compete with SIB. These assessments were also inconclusive.

PHASE 2: STIMULUS PREFERENCE ASSESSMENT

Method

Due to the inconclusive results of the functional analyses, stimulus preference assessments (e.g., Pace et al., 1985) were conducted to identify highly preferred stimuli and to develop differential reinforcement treatments. In order to select stimuli for the preference assessment, caregivers (i.e., individuals who had assumed primary care of the client prior to his or her admission) were interviewed using the method described by Fisher, Piazza, Bowman, and Amari (in press). Caregivers were asked to identify stimuli (e.g., items, activities, edible items, social interactions) that were highly preferred by the client. They identified 12 preferred stimuli for Mel and eight for Mark. In addition, hospital staff members identified four other preferred stimuli for each client based on their observations of client preference during the hospitalization. The list of stimuli for each client appears on the horizontal axes of Figure 2.

The preference assessment consisted of a modification of the procedure described by Pace et al. (1985). During each session, four stimuli were presented five times each in a randomly determined order for a total of 20

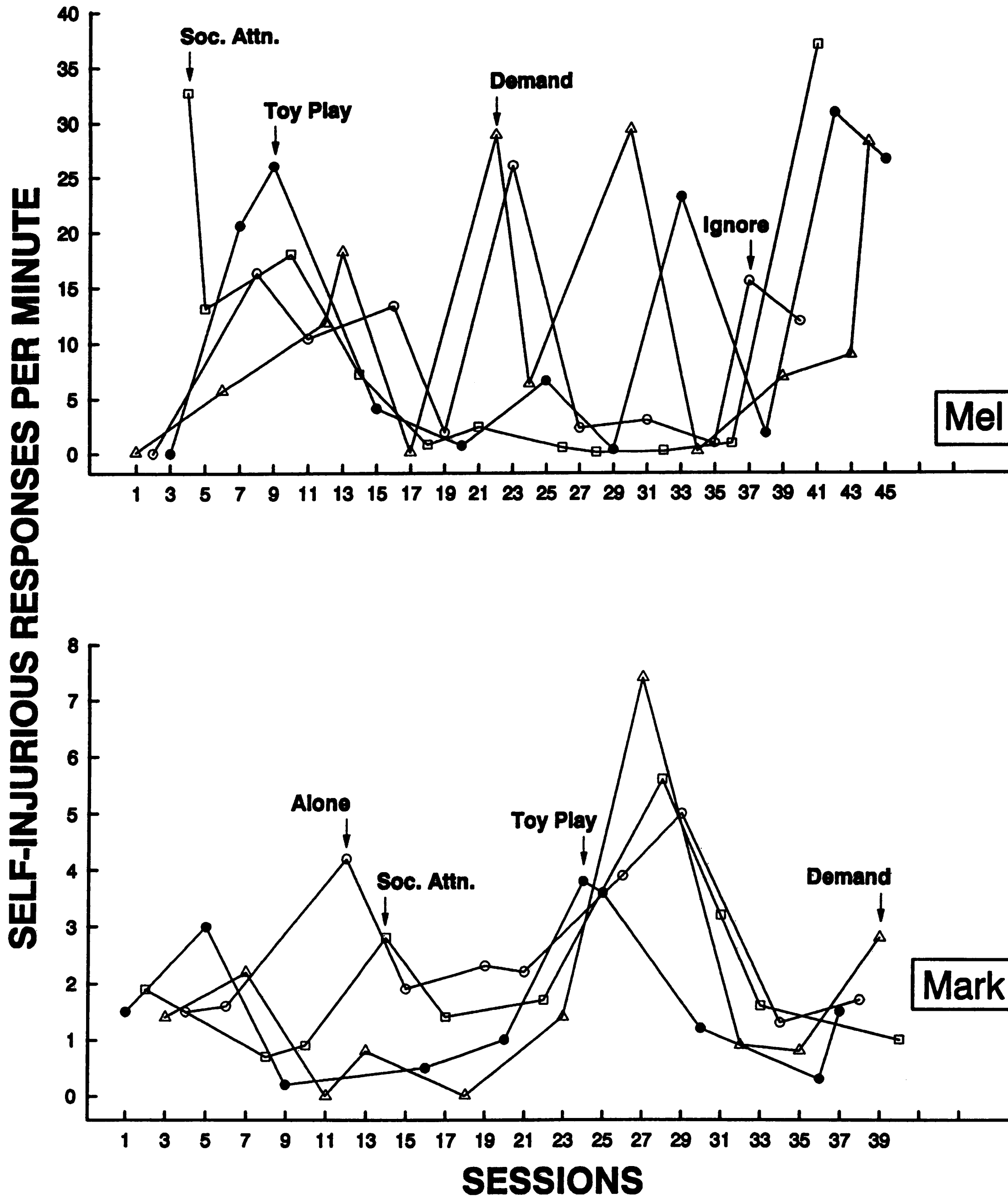

Figure 1. Responses per minute of SIB during analogue functional analyses for Mel (top panel) and Mark (bottom panel).

stimulus presentations. Stimuli were presented one at a time. Eight sessions were conducted with Mel, and six sessions were conducted with Mark, such that each stimulus was presented a total of 10 times across sessions for a total of 160 stimulus presentations with Mel and 120 with Mark. Before each stimulus presentation or trial, the client was allowed to sample the stimulus for 10 s. The sample was included to insure familiar-

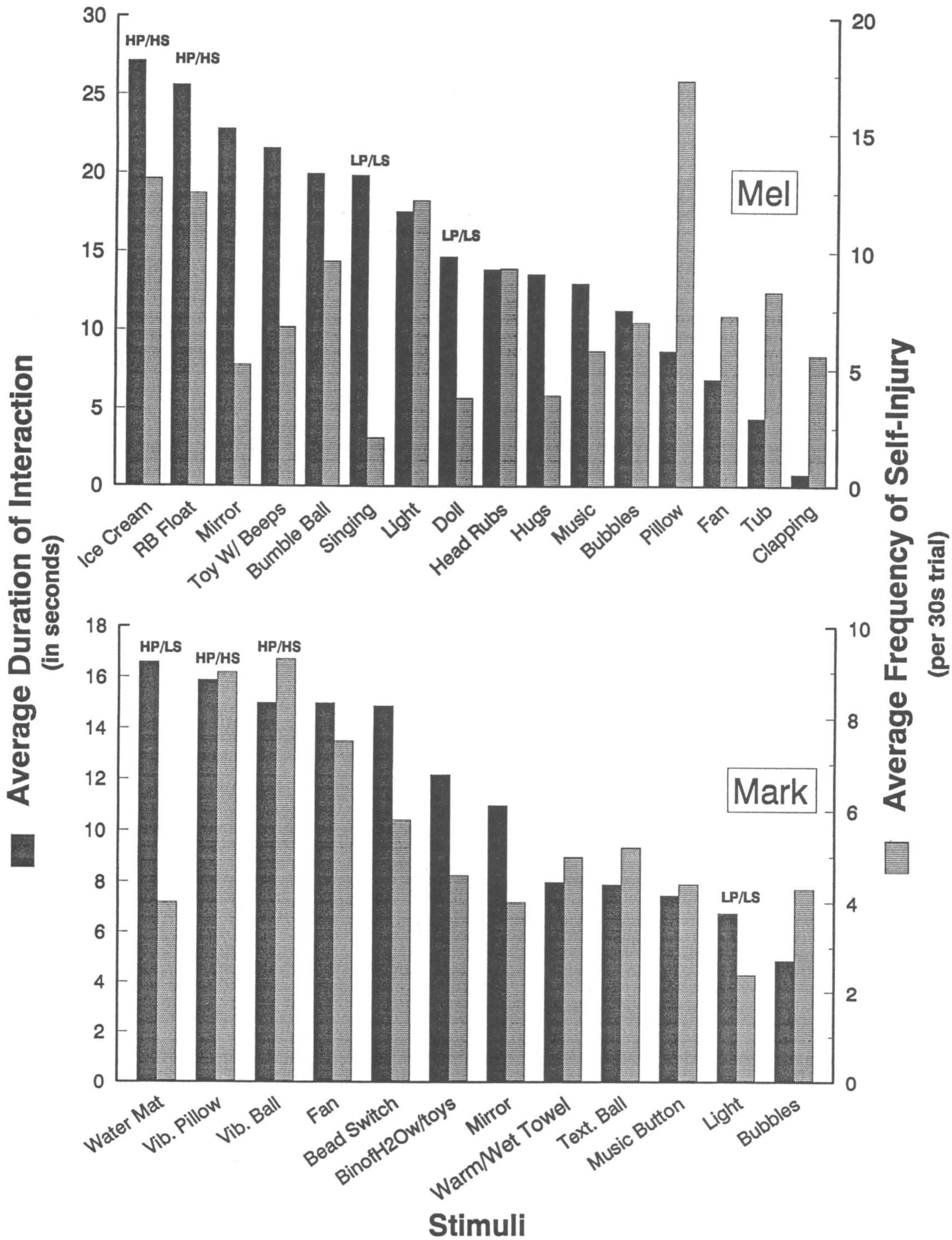

Figure 2. The duration of interaction in seconds and the frequency of SIB averaged across the 10 30-s trials for each stimulus during the preference assessment for Mel (top panel) and Mark (bottom panel).

ity with the stimulus (Pace et al., 1985). Sampling was accomplished for (a) items by giving the item to the client, (b) edible items by giving the client a small portion of the food, (c) activities by engaging in the activity with the client, or (d) social behaviors by performing the social behavior (e.g., clapping for the client). After the stimulus sampling procedure, the trial began by blocking SIB while simultaneously presenting the stimulus to the client. SIB was blocked to avoid adventitious reinforcement (i.e., to prevent the co-occurrence of SIB and presentation of the stimulus). Blocking was discontinued when the stimulus had been presented (e.g., after the client was given the ball). Presentation of the stimulus was identical to that described for sampling, except that the client had access to the stimulus for 30 s. For edible items, a small portion of food was placed in front of Mel's mouth each time she completed the previous portion such that the food item was continuously available during the 30-s trial. During each trial, the duration of interaction was recorded as the measure of preference; the frequency of SIB was also recorded.

Data Collection and Reliability Checks

Data were collected on duration of interaction (in seconds) and the frequency of SIB during each 30-s stimulus presentation. Trained observers used timers to record the duration of interaction and counted and recorded on paper the frequency of SIB during each 30-s trial. Interaction was defined individually for each item but generally included orientation toward the stimulus, manipulation of the stimulus in the manner in which it was intended, or consumption of edible items. For example, interaction for the vibrating pillow was defined as touching the pillow with any part of the body, and the definition for ice cream was putting the ice cream past the lips. Definitions for SIB were identical to those used for the functional assessment.

Two independent observers scored target responses simultaneously but independently during 35% and 50% of the stimulus preference assessment trials for Mel and Mark, respectively. Agreement coefficients were calculated by dividing the smaller duration (for interaction) or frequency (for SIB) by the larger duration or frequency and multiplying by 100%. Mean agreement coefficients for Mel were 83% for duration of interaction and 84% for frequency of SIB, and for Mark were 81% for duration of interaction and 94% for SIB.

Results and Discussion

The results of the stimulus preference assessments for both clients are depicted in Figure 2. The duration of interaction (i.e., the measure of preference) and the frequency of SIB were averaged across the 10 30-s trials for each stimulus. In the figure, the stimuli are presented in order from high to low preference (left bar), with the associated frequencies of SIB in the adjacent right bar. For Mark, the most highly preferred stimulus (water mat) was associated with relatively lower rates of SIB (i.e., relative to the rate of SIB associated with other high-preference stimuli). The most highly preferred stimuli for Mel (root beer float and ice cream) and the second and third most preferred stimuli for Mark (vibrating ball and pillow) were associated with high rates of SIB. That is, when the stimulus was presented noncontingently, the client engaged in both high durations of interaction, thus indicating a preference for the stimulus, and high rates of SIB. This was unexpected, in that high-preference stimuli have not been found to occasion maladaptive behavior but have been demonstrated to reduce problem behavior when presented either noncontingently (e.g., Vollmer et al., 1994) or contingently (e.g., Dyer, 1987; Mason et al., 1989). For both clients, the lowest rates of SIB were associated with relatively low-preference stimuli (singing and doll for Mel and light for Mark).

In most investigations on stimulus preference (e.g., Fisher et al., 1992; Green, Reid, Canipe, & Gardner, 1991; Pace et al., 1985), the most highly preferred stimuli were functional reinforcers but less preferred stimuli were not. In the current investigation, the purpose was to assess the extent to which stimulus preference assessments such as the one used by Pace et al. (1985) predict the effectiveness of highly preferred stimuli in the treatment of SIB. That is, are measures of preference for stimuli sufficient for determining reinforcer effectiveness in differential reinforcement procedures or do concurrent observations of SIB during stimulus presentation enhance the accuracy of reinforcer identification? In order to answer this question, the most highly preferred stimuli were compared with stimuli that were associated with the lowest rates of SIB.

In order to provide labels for the different stimuli, the most highly preferred stimuli were labeled HP stimuli, and the stimuli associated with the lowest rates of SIB were labeled LS stimuli. The high-preference stimuli for Mark were associated with relatively higher (vibrating ball and pillow) and lower (water mat) rates of SIB. Therefore, it was necessary to add labels that would distinguish these stimuli. Three categories of stimuli were created: (a) high preference, high SIB (HP/HS)—ice cream and root beer float for Mel and vibrating ball and pillow for Mark; (b) high preference, low SIB (HP/LS)—the water mat for Mark and no item for Mel; (c) low preference, low SIB (LP/LS)—singing and doll for Mel and light for Mark. For the high-preference stimuli, the labels for SIB reflected whether the rates of SIB were higher or lower than the rates of SIB associated with all other stimuli. For stimuli associated with low rates of SIB, the labels for preference reflected the preference the client demonstrated for the stimulus relative to all other stimuli. If the stimulus was not in the top three in terms of preference, it was labeled low preference.

PHASE 3: REINFORCER ASSESSMENT

METHOD

A reinforcer assessment (e.g., Fisher et al., 1992; Pace et al., 1985) was conducted to determine the reinforcement effects of the stimuli that had been identified during the stimulus preference assessment. The goal of the reinforcer assessment was to validate previous findings indicating that high-preference stimuli are often functional reinforcers and that low-preference stimuli typically are not functional reinforcers (e.g., Green et al., 1991; Pace et al., 1985).

During each phase of the reinforcer assessment, one type of stimulus (i.e., HP/HS, HP/LS, and LP/LS) was compared with a control. Reinforcer assessment sessions were 15 min in length. Sessions were conducted in a quiet, secluded living area (5 m by 3 m) for Mel and in an individual treatment room (3 m by 3 m) for Mark. For Mel, both HP/HS (root beer float and ice cream) and both LP/LS (singing and doll) stimuli were assessed in pairs, as described by Fisher et al. (1992). For Mark, each stimulus was assessed independently.

Target behaviors that had been used in previous investigations (e.g., Fisher et al., 1992; Wacker, Berg, Wiggins, Muldoon, & Cavanaugh, 1985) to measure reinforcer effectiveness were either not appropriate due to the client's limited mobility (e.g., Fisher et al., 1992) or could not be taught in an efficient manner (e.g., Wacker et al., 1985). Therefore, head turning, a modification of the "look" response described by Pace et al. (1985), was used as the dependent measure.

During the session, the client was seated in a chair in the center of the room. One therapist was located on the right and one on the left side of the client. The stimulus being evaluated (HP/HS, HP/LS, or LP/LS) was held by one of the therapists. The other therapist had no stimulus. The left-right positions of the stimulus and the therapist were counterbalanced to control for therapist or position preference. During the session, if the client's head was oriented toward midline, he or she was prompted to turn his or her head to the left or to the right once every 30 s. The side to which the client was prompted was randomly determined but was divided equally across the session such that the client was prompted to turn to the left 50% of the time and to the right 50% of the time. Prompting was accomplished by physically guiding Mel's head to one side and then letting go. Because Mark resisted physical contact, prompting consisted of the therapist standing in front of Mark and returning to his or her original position (i.e., right or left side). If the client's head remained turned following prompting or turned independently in the direction of the stimulus for 1 s, he or she was given access to the stimulus. Access to the stimulus continued until the client turned his or her head back to midline or in the other direction. If the client's head remained turned or independently turned in the direction of the control therapist, no differential consequence was delivered. No head-turning prompts were delivered while the client's head was turned in either direction. If the client turned his or her head back to midline at any time, prompting resumed according to the 30-s schedule.

Data Collection and Reliability Checks

Data were collected on the total duration (in seconds) of head turning to the left or right side for each session. Trained observers used two timers to record the duration of head turning toward either side. Head turning was defined as the client's head being turned past 45° from midline in orientation to the left or right side.

Two independent observers scored target responses simultaneously but independently during 68% and 91% of the reinforcer assessment sessions for Mel and Mark, respectively. Interobserver agreement was assessed for the duration of head turning by dividing the smaller duration by the larger duration and multiplying by 100%. Mean agreement was 85% for Mel and 88% for Mark.

During the reinforcer assessment, a concurrent operants procedure (Catania, 1992) was used to evaluate the reinforcer effectiveness of the stimuli being assessed in two phases for Mel and four phases for Mark. In the concurrent operants procedure, two operants (in this case, head turning to the left or to the right) were associated with different consequences (i.e., access to stimulus vs. no stimulus). The order of the phases was randomly assigned for the first client (Mel) and then was counterbalanced with the second client (Mark) to help control for order effects. The order of phases for Mel was HP/HS stimuli followed by LP/LS stimuli, and the order of phases for Mark was HP/LS stimulus, LP/LS stimulus, HP/HS stimulus (vibrating ball), then HP/HS stimulus (vibrating pillow).

Results and Discussion

For Mel, the highly preferred stimuli (ice cream and root beer float) were demonstrated to be functional reinforcers for the simple response of head turning. When the stimuli were compared to a control condition using a concurrent operants procedure, the mean duration of head turning toward root beer float and ice cream was 8.8 min, and was 0.6 min for the control. The low-preference stimuli (singing and doll) were not functional reinforcers because head turning did not increase (M = 3.0 min for singing and doll, M = 2.1 min for control).

For Mark, all of the highly preferred stimuli (vibrating pillow, vibrating ball, and water mat) were demonstrated to be functional reinforcers. When these stimuli were compared to the control condition, the mean duration of head turning for vibrating pillow was 3.9 min (1.0 min for control), 3.1 min for vibrating ball (0.8 min for control), and 3.7 min for water mat (0.9 min for control). The low-preference stimulus (light) was not a functional reinforcer because rates of head turning did not increase (M = 1.6 min for light, M = 1.8 min for control).

The results of Phase 3 were consistent with previous research showing that high-preference stimuli were functional reinforcers for simple responses and low-preference stimuli were not (Fisher et al., 1992; Green et al., 1991; Pace et al., 1985). In Phase 4, we evaluated the extent to which the stimulus preference assessment could be used to predict the effects of the various stimuli (HP/HS, HP/LS, and LP/LS) on SIB when they were incorporated into a DRO schedule. We hypothesized that (a) stimuli that were highly preferred and associated with high rates of SIB (HP/HS) during the preference assessment would increase SIB when used in a DRO schedule, (b) stimuli that were highly preferred and associated with relatively lower rates of SIB (HP/LS) would reduce SIB when used in a DRO schedule, and (c) stimuli that had a low preference and were associated with low rates of SIB (LP/LS) would have no effect on SIB when used in a DRO schedule.

PHASE 4: DRO ASSESSMENT

Method

Throughout all phases or conditions, the therapist engaged in casual conversation (e.g., "It's a nice day") with the client. All sessions were 10 min in length.

During baseline, the occurrence of SIB resulted in no differential consequence, and no interaction or stimuli were presented other than casual conversation. The DRO intervals for each client were calculated by averaging the interresponse times during baseline probes conducted for this purpose (Poling & Ryan, 1982). During the DRO schedule phase, Mel was presented with the stimuli every 7 s in which SIB was absent, and for Mark, the DRO interval was 9 s. Occurrence of SIB resulted in a resetting of the DRO clock (Repp & Deitz, 1974). Clients had access to the stimuli for 10 s for manipulable items or received small portions of edible items.

Data Collection and Reliability Checks

During the DRO assessment, the rate (responses per minute) of SIB was recorded on laptop computers by trained observers. Definitions for SIB were identical to those used for the functional analysis. Rate of reinforcement delivery was also scored for Mel throughout all sessions. For Mark, 33% of the HP/HS sessions were videotaped, and delivery of reinforcement was scored from the videotaped sessions. Delivery of reinforcement was defined as the therapist's placing the food in Mel's mouth or placing the stimulus (either the vibrating pillow or ball) on Mark's wheelchair tray. Delivery of reinforcement was scored to determine how frequently the client received the reinforcer during the DRO schedule with the HP/HS stimuli. Obtained reinforcement was calculated by dividing the number of reinforcers actually delivered by the number of times the client had the opportunity to receive reinforcement (i.e., the DRO interval divided by the session length).

Two independent observers scored SIB simultaneously but independently during 54% and 62% of the DRO assessment for Mel and Mark, respectively. Interobserver agreement was assessed for delivery of reinforcement during 44% and 50% of sessions for Mel and Mark, respectively.

During the DRO assessment, exact agreement coefficients were calculated as described for the functional analysis. Exact agreement coefficients were 83% for both Mel and Mark for self-injury. Exact agreement coefficients for delivery of reinforcement were 99.4% for Mel and 98.4% for Mark.

Experimental Design

For Mel's DRO assessment, an ABACAC design was used to evaluate treatment efficacy for each type of stimulus used in a DRO schedule (A: baseline; B: DRO schedule with LP/LS stimuli; C: DRO schedule with HP/HS stimuli). The order of stimuli was randomly assigned. For Mark's assessment, a multielement design consisting of four conditions was used. In each condition, the effects of the DRO schedule using the various stimuli were compared to a control. Because two HP/HS stimuli were identified, both were evaluated in the same condition. The order of the stimuli in the DRO assessment was randomly assigned. The order was as follows: Condition 1: DRO schedule with HP/HS stimuli; Condition 2: DRO schedule with HP/LS stimuli; Condition 3: DRO schedule with LP/LS stimuli; Condition 4: return to the DRO schedule with HP/HS stimuli.

Results and Discussion

The results of the DRO assessment are depicted in Figure 3. For Mel, in the first baseline condition, mean rate of SIB was 5.1 per minute. The rates of SIB increased during baseline and continued to increase slightly when a DRO schedule using the LP/LS stimuli was implemented following baseline (M = 9.2). Following a return to baseline (M = 7.1), the HP/HS stimuli were evaluated in a DRO schedule. Rates of SIB increased when a DRO schedule was conducted using the HP/HS stimuli, and this effect was replicated during a reversal (M = 15.0 across both HP/HS conditions). During the DRO schedule with the HP/HS stimuli, Mel obtained reinforcement 17.7% of the time that reinforcement was available.

For Mark, during the first multielement condition, the DRO schedule using one HP/HS stimulus (vibrating ball) resulted in a mean rate of SIB of 20.6; the DRO schedule using the other HP/HS stimulus (vibrating pillow) resulted in a mean rate of SIB of 12.1. The control condition (i.e., no DRO schedule) resulted in a mean rate of SIB of 9.8. Thus, a DRO schedule with HP/HS stimuli resulted in increased rates of SIB. In the second multielement condition, a DRO schedule using the HP/LS stimulus was compared to a control. Rates of SIB were comparable during HP/LS (M = 5.2) and control conditions (M = 4.4). In the third multielement condition, the rates of SIB were 5.7 during a DRO schedule using the LP/LS stimulus and 6.7 during the control condition. Because the overall rates of SIB appeared to decline across conditions, the multielement condition with HP/HS stimuli was replicated to determine if the relative differences in the rates of SIB found in the first HP/HS condition persisted. Although the overall lower rate of SIB was maintained, the relative differences between rates of SIB during the DRO schedule with vibrating ball (M = 12.2), the DRO schedule with vibrating pillow (M = 5.0), and the control (M = 2.5) conditions were comparable to the initial HP/HS condition. Thus, the DRO schedule with the HP/HS stimuli resulted in a relative increase in SIB when compared to the control condition. During the DRO schedule with the HP/HS stimuli, Mark obtained reinforcement 35% of the time that reinforcement was available.

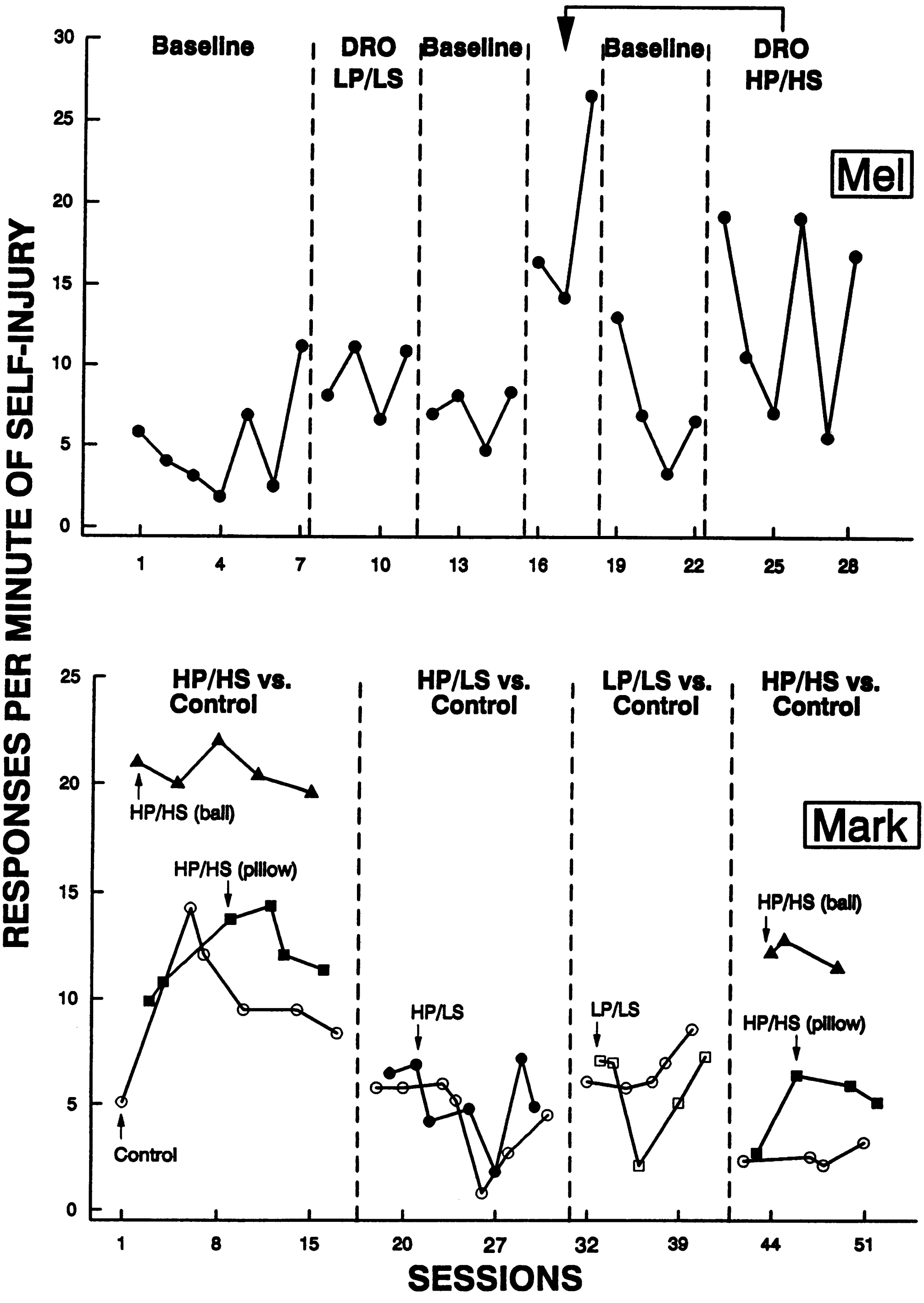

Figure 3. The responses per minute of SIB during the DRO assessment for Mel (top panel) and for Mark (bottom panel).

GENERAL DISCUSSION

The goal of the current investigation was to examine the extent to which a stimulus preference assessment predicted the positive (reinforcing) and negative effects of stimuli on SIB when used in a differential reinforcement procedure. We attempted to assess whether reinforcers identified in one context (stimulus preference and subsequent reinforcer assessments) predicted reinforcer effectiveness in another context (differential reinforcement treatment). We also evaluated the extent to which conducting concurrent observations of SIB during the preference assessment would enhance the accuracy of reinforcer identification for the differential reinforcement treatment. As a result of these assessments, three types of stimuli were evaluated: (a) high-preference stimuli associated with high rates of SIB (HP/HS stimuli), (b) high-preference stimuli associated with low rates of SIB (HP/LS stimuli), and (c) low-preference stimuli associated with low rates of SIB (LP/LS stimuli).

The HP/HS stimuli consistently functioned as reinforcers when presented contingent on a simple response (e.g., head turning) during a reinforcer assessment. When these stimuli were presented contingent on the absence of SIB during DRO treatment, they consistently resulted in increases in SIB. These results suggest that reinforcers identified for one behavior do not necessarily predict reinforcer effectiveness for another behavior. However, the findings also suggest that concurrent observations of SIB conducted during the stimulus preference assessment may be useful for identifying stimuli that produce negative side effects when used in a DRO schedule to treat SIB.

The LP/LS stimuli were not functional reinforcers for head turning during the reinforcer assessment. When LP/LS stimuli were presented contingent on the absence of SIB during a DRO treatment, the rates of SIB were comparable to the baseline control condition for both clients. Thus, the results of the stimulus preference assessment accurately predicted the effects of these stimuli (i.e., that they would not function as reinforcers) during both the reinforcer assessment and during the DRO treatment. Stimuli that did not function as reinforcers for one simple behavior (head turning) did not function as reinforcers for a different behavior (the absence of SIB), even though the stimuli were associated with low rates of SIB during the preference assessment.

One HP/LS stimulus was evaluated with Mark. When this stimulus was presented contingent on the absence of SIB during DRO treatment, the rates of SIB were comparable to the control condition. Although this HP/LS stimulus was a functional reinforcer for head turning during the reinforcer assessment, it was not a functional reinforcer for the absence of SIB during the DRO treatment. Thus, the stimulus preference assessment predicted the positive effects of this stimulus during the reinforcer assessment but not during the DRO treatment for SIB. One possible reason for this discrepancy is that although the water mat was an effective reinforcer for head turning (a very simple response), it did not effectively compete with SIB (a high-probability response). These findings may highlight one of the limitations of stimulus preference and reinforcer assessments. Identification of reinforcers for simple behaviors may not adequately predict reinforcer effectiveness for other behaviors such as the absence of SIB.

A second possible explanation for this discrepancy is that although this stimulus was associated with lower levels of SIB relative to other stimuli evaluated during the preference assessment, the absolute level of SIB was still rather high (approximately eight per minute). In comparison, the rates of SIB averaged 6.1 per minute during the baseline condition used for the DRO treatment. This stimulus may have been mislabeled as an LS stimulus. In future investigations, it may be useful to include a control condition during the stimulus preference assessment, one in which no stimulus is present and the levels of SIB are measured. Stimuli could then be identified as HS if the rates of SIB associated with the stimulus were higher than those during the control condition when no stimulus was present. Conversely, stimuli could be identified as LS if the rates of SIB associated with the stimulus were lower than those during the control condition.

The reasons for the increases in SIB associated with the HP/HS stimuli during the preference assessment and DRO treatment remain unclear. The explanation we find most parsimonious is that the HP/HS stimuli occasioned SIB. It may be the case that when variables that maintain SIB are unknown, access to high-preference stimuli suppresses SIB only when (a) the stimuli are functional reinforcers and (b) the client cannot obtain the preferred stimuli and the reinforcers for SIB simultaneously. In the current investigation, the HP/HS stimuli may have been functional reinforcers but may not have effectively competed with the reinforcers for SIB. Thus, the client may have been able to engage in SIB, obtain the reinforcer for SIB, and obtain the preferred stimulus simultaneously.

During DRO treatment, the clients may not have discriminated that SIB resulted in the nondelivery of reinforcement. That is, during a DRO schedule, the client is presented with the reinforcer (in this case the HP/HS stimuli) for the absence of SIB, and the occurrence of SIB results in a delay or omission of reinforcer presentation (Reynolds, 1961). The interresponse interval for the DRO schedule was set by calculating the mean interresponse time in baseline probes (Poling & Ryan, 1982). In the current investigation, the DRO intervals were very short, due to the high rate of SIB during baseline. Because of the short interresponse intervals, the clients may not have discriminated that their SIB was resulting in nondelivery of the reinforcer, and no procedures were used to facilitate discrimination beyond delivery of the contingencies. This failure to discriminate contingencies may have been further exacerbated by the functioning level of the clients. Clinically, this study may highlight one potential limitation of DRO schedules with very low-functioning clients who display high rates of SIB. DRO schedules may be contraindicated for clients whose rates of SIB are high and who may not discriminate DRO schedule contingencies. Future investigators might explore the extent to which providing additional discriminative stimuli for DRO schedule contingencies is useful.

There are a number of alternative explanations of the findings. The increases in SIB during the HP/HS conditions could represent an extinction burst. If so, DRO treatment phases may have been terminated prematurely. Clients had long histories of SIB, and such short conditions (three to five sessions) may not have been sufficient to achieve suppression of SIB. However, examination of the interval-by-interval data for both clients revealed that responding was steady within and across sessions. Further, clients were sustaining tissue damage during these sessions, and the medical team was opposed to an extended phase with HP/HS stimuli. Alternatively, increases in SIB during the HP/HS conditions may have occurred because the client could maximize reinforcement by engaging in brief periods of nonresponding, thereby earning the empirically identified reinforcer, followed by bursts of SIB, thereby obtaining the automatic reinforcer of SIB. However, few reinforcers were delivered during this phase (17.7% of available reinforcement for Mel and 35% for Mark), and examination of the interval-by-interval data indicated that responding was relatively steady within the session.

One limitation of the current investigation is that only a few stimuli were evaluated, and DRO schedules with these stimuli were not effective in reducing the SIB of either client. In most investigations on stimulus preference assessment, the most highly preferred stimuli are functional reinforcers, but low-preference stimuli are not. Thus, in the current investigation only the effectiveness of the most highly preferred stimuli was assessed and compared to the stimuli associated with the absolute lowest rates of SIB during the stimulus preference assessment. Had the criteria for categorizing HP, LP, HS, and LS stimuli been different (e.g., including moderately preferred stimuli that were associated with low rates of SIB), more effective reinforcers may have been identified for use in the DRO schedules. Although improvements in preference and reinforcer assessments have facilitated our ability to identify effective reinforcers for persons with severe to profound disabilities (Fisher et al., 1992; Green et al., 1991; Pace et al., 1985), continued research is needed to understand the extent to which these assessments can be used to treat SIB successfully.

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STUDY QUESTIONS

1. What two purposes did the proposed assessment procedure serve and what is their relevance to the design of treatment procedures for reducing the frequency of behavior problems?
2. During the functional analysis phase of the study, one of the conditions involved toy play. The procedures in this condition differed somewhat for Mel and Mark. What were these procedures and how would they best be described from the standpoint of basic process?
3. What general pattern of responding was observed during the functional analyses, and how did the authors interpret these results?
4. How was the stimulus-preference assessment conducted, and what designations were given to the stimuli based on the results obtained?
5. What was the purpose of the reinforcer assessment? How was it conducted and what general results were obtained?
6. Three types of stimuli were evaluated during the DRO phase of the study: HP/HS, HP/LS, and LP/LS. What effects did these stimuli have on rates of SIB when compared to their respective baselines, and which outcome would not have been predicted based on results obtained in previous phases of the experiment?
7. The authors indicate in their discussion that the designation of HP/LS given to the water mat may have been an error. On what data was this conclusion based?
8. One general finding of the preference-assessment phase of the study was that, although subjects interacted with many of the stimuli during at least some portion of the access interval, they also engaged in SIB frequently. In other words, it appeared that many of the stimuli might, depending on the criteria used for classification, be designated as HP/HS. The authors described the effects of such stimuli during the DRO phase by referring to the fact that the stimuli appeared to occasion SIB. From the standpoint of general theory, how might one characterize reinforcers whose presentation is associated with increases in other behaviors?